INTEGRATING C-17 DIRECT DELIVERY AIRLIFT
INTO TRADITIONAL AIR FORCE DOCTRINE

GRADUATE RESEARCH PROJECT

Creighton W. Cook Jr, Major, USAF

AFIT/GMO/LAC/98J-3

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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GRADUATE RESEARCH PROJECT

Presented to the Faculty of the Graduate School of

Logistics and Acquisition Management of the

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the

Requirements for the Degree of

Master of Mobility

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June 1998

Approved for public release; distribution unlimited

Acknowledgments

I wish to extend thanks to my AFIT advisor, Dr. David K. Vaughan. The time and effort he gave to keep my research project focused and coherent is greatly appreciated. I would also like to acknowledge Ms. Janice Missildine, the Air Mobility Warfare Center librarian, for the enthusiasm and hard work she put forth in helping to research this subject. Finally, I must express thanks to my wife, Kathy, and my children, Katie, Ashley, and Ethan, for their good-natured support and understanding throughout this year long endeavor.

Creighton Cook

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Abstract

Airlift is critical to a national military strategy increasingly dependent on strategic mobility to deploy U.S. and multinational forces. Airlift doctrine, the very principles that describe how this airlift should be used, has remained relatively unchanged for the past thirty years. Consequently, the traditional "hub and spoke" airlift process remains as the Air Force's fundamental airlift deployment strategy. Today, the C-17 is a next generation airlifter capable of direct delivery, but the Air Force's reluctance to integrate direct delivery within traditional airlift doctrine may be degrading the efficiency and effectiveness of our national airlift capability.

Airlift will always be a scarce resource. Airlift doctrine needs to be updated to take advantage of the rapid force projection capability direct delivery airlift can provide. This paper discusses the evolution of the C-17 direct delivery airlift capability and highlights the need to integrate this capability within current Air Force doctrine. It begins with a discussion of the original doctrine that led to a vision that our nation needed a direct delivery capability. Then follows the evolution of direct delivery from the initial concept, to aircraft development, to the operational capability that exists today with the advent of the C-17. It concludes with a proposal of a direct delivery utility model that would be beneficial in determining when to employ direct delivery in an airlift operation.

INTEGRATING C-17 DIRECT DELIVERY AIRLIFT

INTO TRADITIONAL AIR FORCE DOCTRINE

I. Introduction

Background

The traditional airlift flow, or "hub and spoke" process, is built around both strategic and tactical airlift. In this traditional scenario, strategic airlift aircraft carry cargo, long-range, from an Aerial Port of Embarkation (APOE) in the continental United States (CONUS) to an intermediate-staging area, a hub, known as the Aerial Port of Debarkation (APOD). At the APOD, the cargo is downloaded from these larger strategic airlift aircraft, temporarily stored, then uploaded onto smaller tactical airlift aircraft. Once loaded, the tactical airlift aircraft complete multiple sorties to a forward operating base (FOB), offloading the cargo close to where it is needed.

A direct delivery operation bypasses the hub and eliminates the need for an intermediate-staging base. As early as 1986, with a C-17 direct delivery capability on the horizon, the Air Force recognized the need to propose one commonly accepted definition of direct delivery for use in publications or other official literature. The result was a study that defined airlift direct delivery as "the air movement of cargo and troops from out-of-theater airfields directly to those in-theater operating bases (landing zones, extraction zones, or drop zones) located nearest to desired final destinations" (Mueh, 1986: 2). By 1989, this evolved into the following definition of direct delivery:

> The strategic air movement of cargo and personnel from an airlift point of embarkation to a point as close as practicable to the user's specified final destination, thereby minimizing transshipment requirements. Air direct

delivery eliminates the traditional Air Force two step strategic and theater airlift transshipment mission mix. (JCS, 1989:21)

In the past, the Air Force may have been able to support direct delivery operation with various types of weapon systems depending on the size and conditions of the FOB. Unfortunately, this possibility was usually the exception, not the rule. In 1995, when the C-17 Globemaster III achieved initial operational capability, the Air Force gained a new capability to consistently deliver cargo directly to small, austere airfields. This event rekindled the question of how to integrate C-17 direct delivery into a traditional, "hub and spoke" airlift flow.

Intertheater and intratheater airlift are sound strategies that have been proven in the past, and will remain the backbone of any sustained airlift flow in the future. However, civilian trends toward reduced inventory, direct vendor delivery, and reliance on premium transportation modes are revolutionizing how the transportation industry operates in the global marketplace. These trends can be used as a catalyst for creating a similar strategy within the defense transportation system (DTS). When appropriate, a direct delivery strategy could add value for each customer in the defense transportation process.

The Problem

Military airlift operations have long been earmarked by a "hub and spoke" doctrine that established large intermediary-staging bases away from the final destination of the cargo. This traditional doctrine was effective when a gradual build up of forces was needed, excess airlift capacity existed, or degraded command and control capabilities required forces to be pooled at an intermediate-staging area for the warfighting Commander in Chief (CINC) to efficiently manage. This doctrine needs to be updated. Political instabilities of the post Cold War era, an explosion in information technology, and the downsizing of the overseas enroute structure are tarnishing some of the traditional advantages this airlift doctrine once offered.

The Air Force rarely uses the C-17 in a direct delivery role during military airlift operations. To understand why, requires an appreciation of how the concept of direct delivery originally surfaced, and why yesterday's visionaries believed it was an important capability. The direct delivery system is a subsystem of the much broader defense transportation system. This subsystem is comprised of four interrelated elements, that when linked together allow the integration of direct delivery operations within traditional Air Force doctrine (Figure 1). These elements are doctrine, concept and development, capability, and employment.

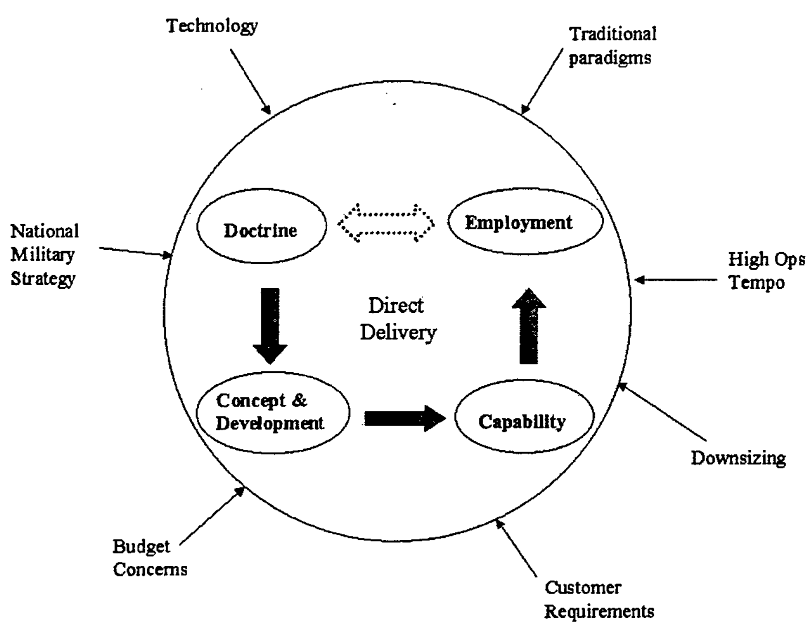

Figure 1. Evolution of the Direct Delivery System

In the early 1960s, the idea for direct delivery was born from limitations found in traditional "hub and spoke" doctrine. From this idea or vision, direct delivery became a concept that developed into the present day capability now embodied in the C-17. This evolution is shown as a counterclockwise flow (Figure 1) between elements to reflect the challenges that have been and must continue to be overcome to complete the cycle and make the direct delivery system effective. Challenges are represented as external influences shown by arrows that point toward the process, continually shaping the direct delivery system as a whole. The large, solid arrows linking three of the four elements represent successful linkages that have already been accomplished during the journey to fully integrate a direct delivery subsystem within the larger defense transportation system.

The linkage between employment and doctrine still needs to be completed. To close this gap, direct delivery needs to be employed on a regular basis so traditional doctrine can embrace direct delivery and integrate its strengths into airlift operations. This new enhanced doctrine will then freely flow back to the employment element, and provide a fundamental basis for identifying how direct delivery should be employed in future airlift operations. Once the linkage is complete, direct delivery will become a part of Air Force doctrine.

Organized by the four elements in the evolution of direct delivery, this paper studies the rationale for developing direct delivery doctrine and employing the capability in the future. It begins with a brief history to explain how the conventional "hub and spoke" operation evolved into the definitive way a military airlift system should work. The paper then examines the C-17's role in direct delivery, from the initial concept as a next generation airlifter to its present day capabilities. The final section on employment proposes how to close the gap, and establish a linkage between the employment and doctrine elements of the direct delivery system.

II. Doctrine

> Air and Space doctrine is a statement of officially sanctioned beliefs and war-fighting principles that describe and guide the proper use of air and space forces in military operations. (Air Force Basic Doctrine, 1997:1)

Doctrine offers the commander, planner, and operator guidance on how to fight and win. It is built for the future by figuring out what has worked best in past exercises, operations, and combat. In the realm of air mobility, doctrine educates and articulates the best methods available for providing rapid global mobility to our nation. It is important we understand these fundamentals of the past to build the airlift doctrine that will work tomorrow.

Air Force Manual 1-1, United States Air Force Basic Doctrine, discussed airlift and its contribution to conventional warfare for the first time in 1964. It stated

> airlift contributes to rapid concentration of air and ground forces and resupply of tactical units in the field. In addition, long range or strategic airlift participates in the support of heavy logistic requirements. Air superiority is required for effective airlift, and close control is necessary for the efficient utilization of tactical airlift. (United, 1964)

The foundation for modern airlift doctrine was established, but each major command was still responsible for providing the details of its specific mission. The two primary missions were classified as strategic and tactical airlift. Strategic airlift, tasked to the Military Air Transport Service (MATS), included the continuous movement of units, personnel, and material between area commanders, and between the CONUS and an overseas area. Strategic airlift assets had the capability to airland or airdrop troops, supplies, and equipment to augment tactical air forces (Fricano, 1996:40-43).

Tactical airlift, assigned to Tactical Air Command (TAC), provided the immediate and responsive air movement of combat troops and supplies directly into objective areas through landing, extraction, and airdrop. Tactical airlift assets had the capability of providing air logistic support for all theater forces, including those engaged in combat operations (Theater, 1954).

In September 1965, Military Air Transport Service (MATS), MAC's predecessor, submitted a draft of AFM 2-21, Airlift Doctrine, to Headquarters USAF for approval. It proposed the consolidation of tactical and strategic airlift missions under one doctrinal manual, describing airlift as a system of deployment, assault, resupply, and redeployment. The MATS proposal supported the position that all deployment and redeployment missions could be performed under MATS control. Headquarters USAF disapproved the MATS proposed draft of AFM 2-21 and directed each command to provide a doctrinal manual for airlift. The Tactical Air Command wrote AFM 2-21, Tactical Airlift, and the newly renamed MAC wrote AFM 2-21, Strategic Airlift (Fricano, 1996:42).

This doctrine remained intact for nearly 25 years until MAC revised the regulations in 1990 to consolidate strategic and tactical airlift doctrine into one new manual with a proposed designation of AFM 2-40, entitled "Airlift Doctrine" (Fricano, 1996:42). Doctrinally, this was the first time airlift was thought of a single system, instead of two separate processes broken into strategic and tactical airlift. Even today, the strategic and tactical division of airlift remains a well established, cultural paradigm that is only beginning to change. Doctrine is a documentation of history that shows future operators and planners those things that have worked well in the *past*, not necessarily a vision of what should work well in the future. As result, up-to-date airlift doctrine for direct delivery still needs to be written.

A robust airlift operation was critical to the successes of "Flying the Hump" in WWII, the Berlin Airlift, and Desert Storm. All were based on operations where forces were built up over time using large, intermediate-staging bases. Examples of successful airlift operations delivering directly into battle are found in the 78 day combat resupply of Khe Sanh in 1968, the airborne operation in Grenada in 1983, and the assault on Rio Hato Airfield in Panama by airborne forces during Operation Just Cause in 1989 (Airlift, 1995:4). The need for aerial delivery is an important aspect of airlift's ability to project forces; however, the strength of the C-17 is found in direct airland delivery.

Currently, according to Air Force Doctrine Document 30, Airlift Operations, the overall objective of airlift is the projection of U.S. national power across the full spectrum of military and political actions. To this end, airlift performs three basic objectives. First, airlift provides rapid and flexible force mobility options that allow military forces to respond to and operate in a variety of circumstances and time frames. Second, airlift provides the unique ability to deliver and sustain specially matched combat forces directly into battle from distant bases. Third, airlift forces are key to the execution of a wide range of non-lethal military operations such as foreign humanitarian assistance (Airlift, 1995:3).

Airlift's most critical effect is felt in the initial thrust of an operation. Therefore, a vital way to improve airlift force projection is to shorten the time it takes to deliver cargo at the onset of a crisis. Direct delivery is an option that can compress the airlift process in the initial days of a crisis reaction and become a force multiplier for the operation. In other words, the use of direct delivery airlift early in a contingency maximizes the combat power available to the Joint Forces Commander (Airlift, 1995:6).

Current doctrine divides airlift into three functional classifications of strategic, theater, and organic. The only mention of direct delivery as a functional classification of airlift is found in the statement, "new airlift designs, such as the C-17, are bridging the gap between longer-range strategic airlift requirements and fully capable theater airlifters" (Airlift, 1995:8). However, there is no guidance on how these new airlift designs should be employed. Because organic airlift forces are not common user assets, these forces would have little impact on a direct delivery operation (Airlift, 1995:8-10).

Strategic airlift forces provide the air bridge that links overseas theaters to the CONUS and to other theaters. These aircraft are normally longer range, and larger capacity than theater airlift aircraft. Theater airlift forces provide common user airlift of personnel and material within a CINC's area of responsibility (AOR). These missions generally require smaller aircraft that are capable of operating into austere, unimproved airfields. The scope of this paper precludes an analysis of the common user airlift command and control relationships. However, it is important to recognize that historically, strategic airlift forces have been controlled by USCINCTRANS and theater airlift forces by the Theater CINC.

During contingency operations, United States Transportation Command (USTRANSCOM) will task strategic airlift from Air Mobility Command to fulfill the needs the of the supporting CINC and operations order (OPORD). In this scenario, forces and their equipment are assembled according to the Time Phased Force Deployment Data (TPFDD) listed in the OPORD and brought to the aerial ports of embarkation. In almost all cases, the airlift customer during a contingency requires AMC to carry cargo to the destination as quickly as possible. The better trained the customer is in readying cargo for deployment, the more quickly it will flow through the APOE and onto the APOD. The most significant factors for supporting the customer are the unit's earliest date of departure and its required delivery date (RDD) at the APOD, which is determined by the supported CINC (Cirafici, 1995: 7).

The enroute portion of the airlift process between the APOE and APOD is determined by the Tanker Airlift Control Center (TACC) at AMC. The structure of the initial airlift flow is normally calculated by using the Airlift Deployment Analysis System (ADANS). Constraints such as available aircraft, crew limitations, and geographical limitations are loaded into ADANS to determine the traffic flow. USTRANSCOM and AMC make every effort to ensure the cargo arrives at the APOD before the RDD. In some instances, the APOD is the final destination of the cargo, but in other cases, the cargo must then be transshipped and flown or driven to the forward operating base. For instance, in Operation Joint Endeavor, an intermediate-staging base was established at Rhein Main AB, Germany. The APOD was Rhein Main AB; however, the ultimate destination of the cargo was usually Sarajevo, Tuzla, or Tazar. In this scenario, USCINCTRANS was primarily concerned with delivering the cargo to Rhein Main AB, the APOD, although that may or may not have been the cargo's final destination.

General Howell Estes, Jr, the commander of Military Air Transport Service from 1964-1969, was one visionary who helped lay the seeds for direct delivery doctrine three decades ago. He stated,

> The role of modern combat airlift, then, is to airlift combat forces and all their battle equipment, in the size and mix required—with the greatest speed—to any point in the world, no matter how remote or primitive, where a threat arises or is likely to erupt. (General Estes, 1969)

This vision underscored a need for direct delivery—an idea that would someday revolutionize the speed and throughput capabilities of modern combat airlift.

III. Concept and Development

The idea of a flexible, largely U.S. based force that can rapidly deploy is not new. In the early 1960s, studies strongly advocated such a force posture to reduce the costs associated with overseas forces and to increase U.S. flexibility (Dalton, 1990: 14). The result was the development of America's first true strategic airlifter, the jet powered C-141A Starlifter. However, subsequent analyses in the 1960s revealed that C-141s could not transport one-third of an infantry division's equipment, and even less of an armored division's equipment. These analyses led to the development of an aircraft capable of carrying this larger, outsized cargo. To accommodate this outsized cargo, the Air Force helped develop the world's first "jumbo" jet, the Lockheed C-5A Galaxy. It was capable of carrying not only three times the load of the C-141, but also outsize equipment such as tanks and helicopters (Dalton, 1990: 16).

As the last of the C-5A production run was ending in the early 1970s, the Air Force began a new research program to develop a successor to the C-130 tactical airlifter. The Air Force named this decade-long developmental program the Advanced Medium Short Takeoff/Landing Transport (AMST) aircraft program (Scott, 1990: 75). The two prototypes constructed were the Boeing YC-14 and the McDonnell Douglas YC-15 which both took part in a fly off competition in 1976. These aircraft, which contained a wide body cargo box to accommodate the growing number of outsize cargo requirements, employed jet engines and a variety of "powered lift" concepts to significantly reduce takeoff and landing distances (Scott, 1990: 76). These performance improvements offered the potential to significantly increase the number of airfields available for forward delivery of outsize cargo.

In 1978, world events changed the United States focus from producing a short-range tactical airlift aircraft to developing a long-range strategic airlift aircraft (Dalton, 1990: 12). The Iranian revolution shattered the United States strategy for the Persian Gulf that depended on Iran and Saudi Arabia acting together to encourage regional stability and deter Soviet aggression. Consequently, in 1979, President Carter announced the formation of the Rapid Deployment Force (later to become CENTCOM) to establish a credible expeditionary force capable of quickly reaching the Persian Gulf region (Dalton, 1990: 12).

The vast distances involved in getting combat forces to the Persian Gulf led to renewed focus on long range or strategic airlift capabilities. As a result, the Pentagon canceled the AMST program (Scott, 1990: 75). The Department of Defense then initiated studies aimed at creating a long-range airlift aircraft that capitalized on the technologies demonstrated in the two AMST aircraft designs. In December 1979, the Department of Defense launched the groundwork for the C-X program, believing that fundamental changes in the world environment required a re-emphasis on strategic airlift needs, particularly for meeting contingencies in Southwest Asia (Dalton, 1990: 17). The worldwide requirement analyses showed that the new airlifter would have to fly long ranges and carry outsize cargo. In addition, it would have to provide solid tactical performance and agility to open more airfields for global operations. In the spring of 1980, the Air Force requested proposals from American industry to build this new aircraft (Dalton, 1990: 18).

This unique request for proposals defined the movement tasks and the operational environment, not detailed aircraft specifications. Contractors were given the problem--four scenarios, the units to be deployed, and the required closure times (Dalton, 1990: 18). Then, the companies were asked to develop an efficient design to meet these mission requirements at the lowest life cycle cost possible. In January 1981, Boeing, Douglas, and Lockheed submitted their C-X proposals to the Air Force. The evaluation process began based on a congressionally mandated study on mobility requirements that highlighted the need for a tactical capability in strategic airlift to permit direct delivery to small, austere airfields (North, 1993: 42). In August 1981, the Secretary of Defense announced McDonnell Douglas as the winner of the C-X competition, and the winning design was designated the C-17 (Dalton, 1990, 22).

The C-17 was developed over a period of several years; meanwhile, changes in the international environment forced the Air Force to add aircraft to its aging airlift fleet sooner than originally planned. The Secretary of Defense certified the need for the C-17, but directed the Department of Defense to pursue nearer term airlift expansion. In January 1982, the Department of Defense recommended the procurement of 50 C-5Bs and 44 KC-10s, and delayed the C-17's development for budgetary reasons (Bond, 1991: 48).

After acquiring the new KC-10s and C-5Bs, the Air Force again focused on the C-17's development to modernize the nation's aging airlift fleet. However, by the end of the 1980s, dramatic developments in the Soviet Union and Eastern Europe led the Secretary of Defense to initiate a further review of the C-17 program (Banks, 1992: 45). This time the review focused on reassessing the need for the program due to the radically changing international climate. The review examined emerging U.S. national military strategy and found that conventional deterrence of hostilities against the United States and its allies was still important (Banks, 1992: 45). Now, the rapidly changing world combined with a decreasing U.S. forward presence underscored the need for flexible and mobile forces, capable of attaining decisive superiority where and when required. The conclusion was that a strong strategic airlift fleet remained an integral part of the nation's military capabilities, and the production of the C-17 became a reality.

IV. Capability

The C-17 combines current technologies to create a revolutionary airlift capability known as "direct delivery." Cargo and personnel can be flown directly from the United States and delivered exactly where they are needed. The need for this capability was developed by the Air Force from decades of extensive experience with airlift operations in combat, crisis, and peacetime. The C-17 combines the advantages of a strategic airlifter, including range, speed, aerial refueling, and large payload capacity with those advantages of a tactical airlifter, including survivability, ability to operate on short airstrips, and maneuverability in the air and on the ground (North, 1993:43). This highly flexible aircraft was designed to efficiently meet the nation's airlift needs across the entire range of potential scenarios.

The evolution of aviation technology has led to the current "hub and spoke" airlift process. Long range airlifters, such as the C-141 and C-5, transport cargo to major airfields; the cargo is then off loaded from the strategic airlifters, stored as necessary, and transferred to C-130s. The C-130s then deliver the cargo to smaller forward airfields closer to the point of need. Because the C-130 cannot transport outsize equipment, a significant portion of the cargo must be carried to the battlefront by road transport or rail.

A primary objective in the C-17s design was to increase the number of potential airfields available so the aircraft could deliver cargo directly to the forward operating area (Figure 2). This capability increases the speed at which U.S. forces can be built up and decreases the resources required to move them. For each C-17 that could directly deliver cargo where it was needed, up to four C-130 sorties would be freed for the movement of tactical cargo around the battle area (Smith, 1991:88). When employed in this role, the C-

17 would be able to leap over airfields congested with traditional airlifters and deliver integral combat units directly to the battle area. Additionally, the C-17 could enhance lateral mobility by being able to more rapidly reposition combat units within a theater to cope with a fluid battle area. Finally, when the C-17 is placed in harm's way, the design attention given to survivability will keep it operating.

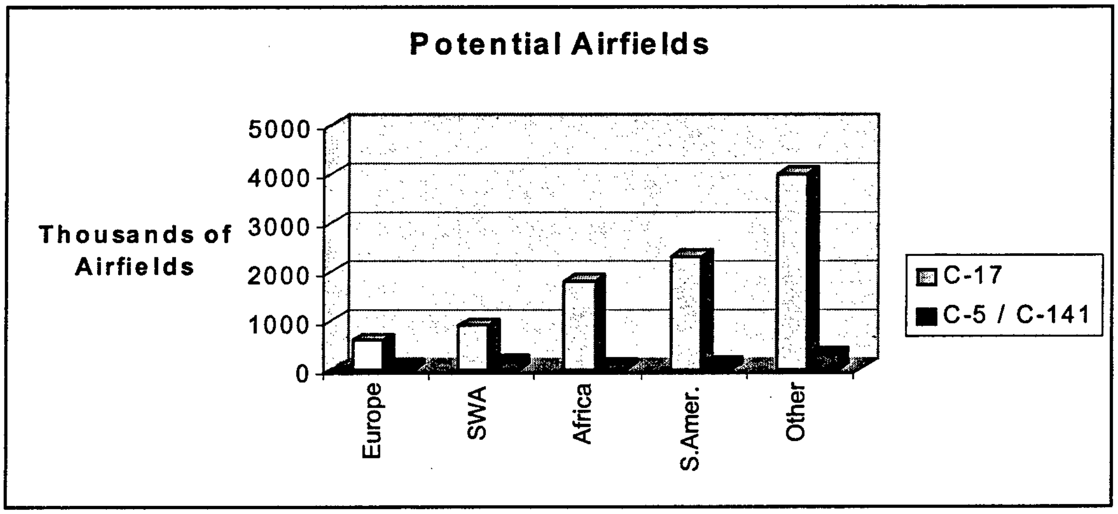

Figure 2. Potential Airfields (Schepens, 1988)

Advanced design concepts incorporated into the C-17 include unique size, propulsive lift technology, and ground maneuverability. In external dimensions the C-17 resembles the C-141B; however, many external differences separate it from any other airlift aircraft. The C-17 fuselage is nearly as wide and high as that of a C-5 and thus provides the aircraft with the capability to carry outsize cargo. Even so, the C-17 wingspan is just 11 feet greater than that of a C-141 (North, 1991:43). The basis for the C-17's dimensions relates to years of experience in operating the C-141 and C-5. The C-141, derived from late 1950s technology, was designed primarily to fly from the United States to major airfields overseas that had relatively long runways. The C-5, on the other hand, was designed with a high lift wing to land on shorter runways and high flotation landing gear to operate on runways with lower strengths. Unfortunately, years of operational experience with the C-5 demonstrated that just high lift performance and high flotation landing gear, the major specifications that C-5 designers worked under in developing the system, did not permit the Air Force to use smaller airfields on a routine basis (Morocco, 1993:78). The C-5 can use smaller airfields on occasion, but the problems raised by the unprecedented size of the aircraft make operations impractical for routine operations and impossible during major airlift contingencies.

The C-17 can carry the same types of cargo as a C-5, but in a more compact vehicle. This compactness is one of the major factors that allow the long-range airlifter to operate into small airfields. The C-17's ability to fly into small airfields on a routine basis is not just a result of physical size, but is created by merging several proven technologies. The use of powered lift based on an externally blown flap principle, directed flow thrust reversers, and advanced avionics equipment permits precise landings in almost any weather conditions (Dornheim, 1993:48).

Externally blown flaps were first employed on the YC-15, the prototype AMST aircraft developed and extensively tested by McDonnell Douglas in the early 1970s (Scott, 1990). With this system, flaps are lowered and placed directly in the jet engine's exhaust stream. Air deflected by the underside of the flaps adds a near vertical lift component, while air blowing over the top of the flaps also increases lift. The use of these flaps enables the C-17 to take off in very short distances compared to conventional aircraft and gives the aircraft exceptional landing performance.

The C-17's technologically advanced avionics greatly enhance the short field capabilities of the aircraft. On board computers interface with a revolutionary "heads up display" (HUD) to provide precise aim point control for landings (Scott, 1990:76). The HUD, in conjunction with the avionics suite of the aircraft and flight control systems, enables the pilot to select the exact point on the ground where the aircraft needs to touch down (Scott, 1990:76). This means the pilot can move the aim point closer to the edge of the runway, effectively decreasing the length of runway required for landing. However, the capability to land at a short strip does not automatically translate into the capability to employ that strip on an operational basis. One of the critical features of the C-17 is that it is the first operational jet airlifter capable of backing up on a routine basis without the aid of ground tugs (North, 1993:42).

The C-17's compact size and exceptional ground maneuverability provide the capability to efficiently use limited ramp space. This capability is critical in theaters that contain numerous small airfields with narrow taxiways and confined parking ramps. The C-17 relies on a new concept of direct flow thrust reversers to back up on the ground. Employing conventionally designed thrust reversers for ground maneuvering typically creates two major problems that prevent their use. First, engines often overheat as they ingest hot gases propelled past their intakes by thrust reversers (Scherbinske, 1991:42). Secondly, the blast from jet engines can damage airfield structures, equipment, and personnel. C-141s, C-5s, and commercial aircraft must be given relatively large amounts of ramp space when off loading or be provided with ground tugs. At most small airfields ground tugs are not available. The C-17's thrust reversers direct engine thrust forward and up, so that the aircraft can back without overheating its engines or disrupting airfield operations.

The capability to back up under its own power adds a number of critical advantages. When maneuvering on the ground, the C-17 can conduct three point turns to reduce its turning radius to only 80 feet, compared to 137 feet for the C-141B (Scott, 1990:76). This permits the aircraft to turn around within the width of most small runways. Ultimately, more C-17 aircraft can park and off load on a ramp than either C-5 or C-141 aircraft. For example, on a 500,000 square foot parking ramp, eight C-17s can park and off load, compared to only six C-141s or three C-5s (Schepens, 1988:12). These capabilities allow the C-17 to deliver more cargo than other long-range airlift aircraft by increasing the throughput capability within the limits of a given ramp space (Figure 3). Though a direct delivery capability exists today, the Air Force still needs to develop the know how, and ultimately the doctrine to successfully employ it.

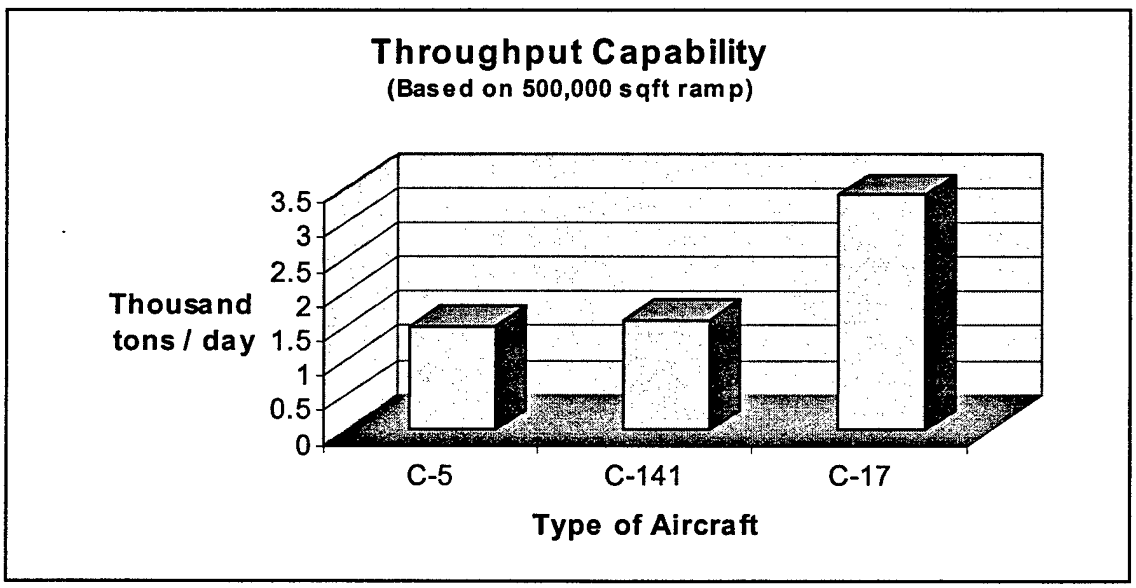

Figure 3. Throughput Capability (Schepens, 1988)

V. Employment

> Present equipment is but a step in progress, and any Air Force which does not keep its doctrines ahead of its equipment, and its vision far into the future, can only delude the nation into a false sense of security. (General "Hap" Arnold, 1941)

A Starting Point

The Air Force, armed with the C-17, has an advanced airlift platform that can provide the most rapid force projection capability our nation has ever known. To take advantage of this capability, the Air Force needs a vision of how to employ the C-17 in a direct delivery role. It is necessary to combine the concepts of intertheater volume and intratheater responsiveness to more efficiently deploy forces during an operation.

Joint doctrine must be updated due to the large role the airlift user has in making direct delivery work. The joint customer, most often the Army, establishes the basic requirement that forms the airlift concept of operation. Today, doctrine still follows the traditional concept of long distant movement to main operating bases and subsequent onward movement to a unit of operation. Intertheater airlift then has the role of moving forces to a theater and makes the theater commander responsible for delivering the forces to the combat areas. The Army understands and believes in this traditional doctrine. Consequently, an integrated doctrine that makes direct delivery a task shared by both the intertheater airlift operator and the theater commander must be regularly exercised to work.

Army doctrine should be updated to allow for the option to increase throughput by using direct delivery when it makes sense to do so. The airlift user must understand the utility of direct delivery to responsibly plan and execute the mission. As this doctrine is jointly modernized, both users and operators will have to work towards packaging forces and support for direct delivery to the FOB. Ultimately, to optimize the C-17's utility for the Air Force and its customers, direct delivery must be a regularly available avenue of transportation for the customer.

Air Force doctrine states, "rapid power projection based in the continental United States has become the predominant military strategy" (Air, 1997:33). DoD logistics measures are shifting from an emphasis on large inventories of parts to rapid resupply through airlift. The large advancement in communication systems allows the Department of Defense to manage the massive volume of information required to keep track of widely dispersed force deployments and shifting supply inventories. Direct delivery would add to these efficiencies and aid in revolutionizing the Air Force's ability to support operations with a smaller force and support structure. In theaters with a small forward deployed force, direct delivery would be a force multiplier when operational success is contingent on the ability to rapidly deploy forces.

As the C-17 assumes a role as one of our nation's primary airlifters, it is imperative the Air Force capitalizes on the aircraft's unique employment strengths. The Air Force and joint users need to understand the scenarios when direct delivery has a positive impact on power projection, and develop the doctrine necessary to support their needs. Since the Air Force will possess fewer total airlift aircraft in the years to come, it is important that today's most efficient airlift methods are written into doctrine.

One such airlift method is based on "just in time" support. It depends on rapid and dependable transportation, in which direct delivery speeds transportation wait times. Direct delivery enables forces to be quickly delivered from the home station to the point of employment without change in transportation mode. When employing direct delivery, inter-modal delays will be reduced and the synchronization of different transportation modes will be virtually eliminated. In scenarios in which reducing costs would become more important than saving time, direct delivery would eliminate the middleman and possibly lower total transportation costs. The C-17 permits rapid throughput into small, austere airfields to maintain the momentum of operations, which allows the commander to outpace the enemy's ability to react.

Rapid mobility is crucial to providing for all of our nation's war-fighting, peacekeeping, and humanitarian operations. Forward deployed forces will continue to decrease, making expeditionary operations the wave of the future. Secretary of Defense William Cohen recently stated, "The increasing complexity of technology, the quickening pace of warfare and growing unpredictability of the international scene require that our people be more adaptable and agile than ever" (Cohen, 1997). To make airlift more adaptable and agile, the Air Force should look towards its own logistics system for examples of how to integrate direct delivery within traditional doctrine.

Finding a Benchmark

The rationale for establishing an integrated direct delivery doctrine is found in the reengineering successes of the Air Force's worldwide logistics system. This recent overhaul of the logistics system aimed at better supporting operational commanders and their combat units is made up of a collection of initiatives known as Lean Logistics. These initiatives are showing logistics can be both more effective and more efficient, ultimately increasing operational capability. Other benefits of Lean Logistics are cost savings, manpower savings, a reduced mobility footprint, and a reduction in the time required to react in an operation.

Lean Logistics increases our military's combat capability. Logistics doctrine is moving away from Cold War support structures characterized by prepositioning, forward presence, and reliance on large inventories. Current logistics strategy is built on a CONUS-based force supporting smaller, fast-developing joint and combined operations. Contingency, peacekeeping, and humanitarian operations are now common, everyday missions. To adapt to these changes in the operating environment, the Air Force logistic strategy has undergone significant change to create a more responsive system. The strategy was based on goals to reduce logistics response time, develop seamless logistic systems, and streamline the logistics infrastructure (Zorich, 1996:2).

The Air Force is moving from an inventory-based logistics system to a transportation-based system. Just as industry has embraced a time-definite method of inventory delivery to lower stock levels, the Air Force is exchanging fast logistics cycle times, along with reductions in logistics cycle variability, to shrink spare stockpiles. By beginning replenishment early and resupplying throughout an operation, units deploy and operate at the same tempo with less inventory and maintenance capability (Zorich, 1996:2).

Lean Logistics strives to produce a system in which logistics information and material flows freely throughout the supply chain across logistics functions, between combat and support units, and between the field and headquarters levels. Information flow resulting from integrated logistics information systems will speed the flow of materiel by streamlining the hand-offs at transportation nodes. It will give logistics managers and users the visibility to "see" assets in the pipeline and react to pipeline logjams. The strategy is to ensure logistics information is available to everyone who needs it.

Lean Logistics streamlines the logistics infrastructure to better support the warfighter by reducing the mobility footprint. Two-level Maintenance (2LM) replaces field-level intermediate maintenance capability with a centralized, CONUS-based, more responsive repair and distribution system. The net effect enables lighter combat units to deploy faster, eliminating a large portion of the airlift requirement for people and equipment. Fewer personnel are at risk in the combat zone and a key "logistics target" is removed from harm's way. Moreover, it reduces the Air Force's expensive peacetime infrastructure.

In many ways, direct delivery mirrors the fundamental concepts embodied in Lean Logistics. Direct delivery initiatives can improve airlift response times, intransit visibility, and ultimately provide better support to the warfighting CINCs. The Air Force bought the C-17, in part for its direct delivery capability, but to date the aircraft has rarely been employed in such a role. A heuristic or model that would help mobility leaders determine when to employ the C-17 in a direct delivery role would be valuable to the Air Force.

Using a Model

Direct delivery may someday be a common employment method for the C-17 and other aircraft during large airlift deployments. To be successful, direct delivery must be effectively integrated into existing models the Air Force uses to plan airlift flows at the beginning of an operation. Initially, to sell the advantages of direct delivery, these models should highlight the benefits of direct delivery by addressing three basic concerns mobility leaders have when setting transportation policies for an airlift flow. The concerns include the questions of how long will it take to get the customers where they want to go, how much will it cost, and what is the best way to use scarce airlift resources.

United States Transportation Command (USTRANSCOM) uses the Joint Flow and Analysis System for Transportation (JFAST) model as a guide to establish the entire transportation flow for an operation (JFAST, 1996). JFAST gives the command a broad-brush view of air, sea, and land assets required to accomplish a large flow. It uses capacity flow simulation to provide closure and capacity estimates, and answer "what ifs." Because it averages many planning factors, the model works well for large deployment plans. Using the TPFDD as input, JFAST constrains aerial and seaports, aircraft and ship characteristics, and cargo requirements. It then uses an airlift scheduler to assign requirements to aircraft assets by priority, and within a set of constraints. The JFAST model accommodates various level of detail, but its broad scope makes it a poor choice to determine the utility of a direct delivery flow (Arostegui, 1998).

The Airlift Deployment Analysis System (ADANS) is the airlift model that makes Air Mobility Command go. It is a vehicle routing model that works very well for aircraft scheduling. First, the model uses heuristics to assign requirements to aircraft and aircraft to missions. The model then schedules missions. This provides the Tanker Airlift Control Center with the number of aircraft required and closure estimates. ADANS is very good for finding a workable solution to complex air mobility problems characterized by thousands of requirements, extensive airfield networks, and hundreds of aircraft.

Though the system could use constraints to force a feasible solution that included direct delivery, it would be limited in its ability to provide the right balance between the two types of airlift methods (Arostegui, 1998).

The ADANS and JFAST models are well suited to planning a large traditional airlift and transportation flow, but are not designed to determine an optimum balance between "hub and spoke" and direct delivery operations. Consequently, neither of these models is practical for mobility leaders to use for making specific policy decisions on the use of direct delivery. A direct delivery utility model is needed to determine how employing the C-17 in a direct delivery role would influence an airlift operation's total cost and employment timeline.

The direct delivery utility model I propose is a basic flow model that could be described or displayed in graphical form known as a network. The model matches necessary cargo and passenger requirements over time with direct delivery airlift capability over time. Any cargo that does not originate from an APOE to be delivered to the FOB is not included in the model. Cargo and passenger requirements are not only identified by the TPFDD, APOE, and delivery date information, but also by an FOB, rather than the traditional APOD.

This model is similar to JFAST in that it looks at the airlift deployment problem as a network flow model. Specifically, the utility model uses a linear program formulation to model a shortest path problem. It determines the shortest route or path through a network from a starting node to an ending node with the objective to minimize either deployment time or cost.

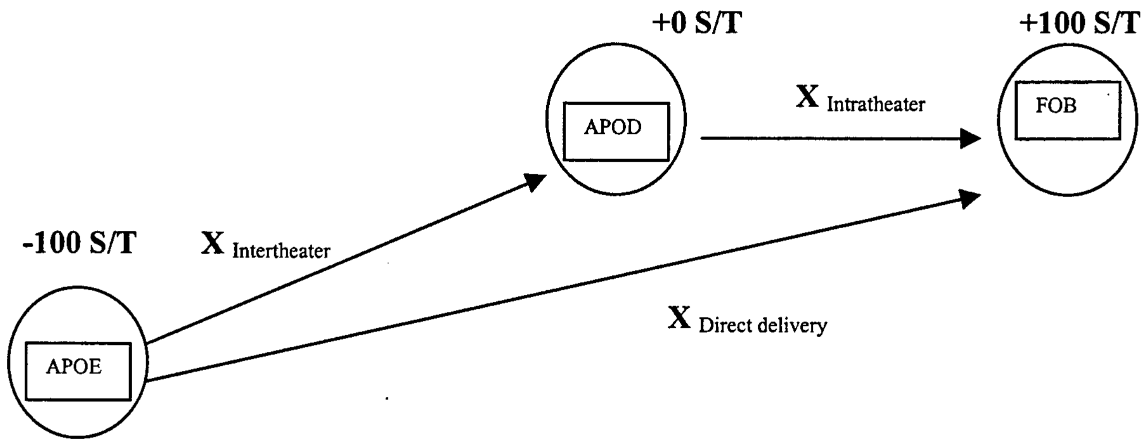

Figure 4. Simplified Network Flow Model

All network flow problems can be represented as a collection of nodes connected by arcs (Figure 4). The circles are called nodes in the terminology of network flow problems, and the lines connecting the nodes are called arcs. The arcs indicate the valid paths, routes, or connections between the nodes with the arrows indicating a direction of flow. The utility model I propose is for force projection and does not account for retrograde cargo movement; thus, all directed arcs point toward the APOD or FOB. The "X" listed on each arc is the cost per sortie, usually in terms of time or money, when that path is followed (Ragsdale, 1998:167).

The notion of supply nodes (or sending nodes) and demand nodes (or receiving nodes) is another common element of network flow problems. The node representing the APOE is a supply node because it has a supply of cargo to send to other nodes in the network. The FOB represents a demand node because it demands to receive cargo from the other nodes. The APOD node in this network is a transshipment node. Transshipment nodes can both send to and receive from other nodes in the network. For example, during Operation Joint Endeavor, Rhein Main AB could be considered a transshipment node because it could receive cargo from CONUS APOEs (supply nodes), and it could also send cargo to demand nodes within the Bosnia AOR.

A positive or negative number next to each node indicates the net supply or demand for each node in the network. Positive numbers represent the demand at the node, and negative numbers represent the supply available at a node (Ragsdale, 1996:169). For example, the value of –100 short tons (S/T) next to the APOD indicates that cargo must decrease by 100 S/T, or that the APOD has a supply of 100 S/T. The value of +100 at the FOB indicates the cargo must be increased by 100 S/T. A transshipment node can have either a net supply or demand, but not both. For the purpose of this model, all cargo is destined from an APOE to an FOB, so any transshipment node would have a net supply or demand of zero.

Assumptions

Assumptions are required to keep the model simple and easy to understand and use. The direct delivery utility model is a prescriptive model that, with these assumptions, specifies the optimal direct delivery airlift traffic flow for deployment in a contingency. Though other assumptions would evolve should a full-scaled model be developed, below are some basic assumptions that must be highlighted at the onset to accurately model a direct delivery scenario.

<u>Direct delivery aircraft:</u> Any AMC or DOD contracted airlift aircraft would be considered a direct delivery asset if it met the requirements to operate into and out of the forward operating base.

Cargo capacity: All direct delivery airlift capacity is considered a scarce resource with no slack or excess capacity available. All available direct delivery assets would be used for direct delivery.

Force Projection: Only evaluates initial deployment of cargo for a contingency operation. No retrograde cargo movement or sustained flow is included in the model.

TPFDD: All TPFDDs will be accurate and available on day one of the contingency.

Intransit Visibility (ITV): No cargo will be mishandled anywhere in the process. There will be 100% ITV from the APOE to the FOB for all cargo and passengers.

Cargo: In this model, "cargo" will be defined as any type of cargo that can be carried by a direct delivery aircraft; including all bulk cargo, oversized cargo, outsized cargo, rolling stock, and personnel.

Traffic Flow: All cargo requires movement from an APOE to an FOB airfield. No cargo will be transshipped at an APOD in the direct delivery scenario. All cargo will be transshipped at an APOD in the traditional scenario.

Constraints

Constraints for the proposed utility model would be similar to other traffic flow models such as ADANS and JFAST. A summary of constraints is listed below.

Ramp space: Each base in the path must have enough ramp space for the plane to park for its ground time.

Material Handling Equipment: Appropriate on-load equipment is available at all APOEs. MHE at the APODs and the FOB airfield will require the appropriate type and number of loaders to be airlifted in.

Refuel: No aircraft would require refueling at the FOB.

Crews: No crew change available at the FOB. Crew change is available at the APOE and APOD.

Throughput: Maximum throughputs for weight, volume, and passengers may not be exceeded.

Weight restrictions: When a weight bearing capacity exists, total aircraft weight must not exceed these limits.

Critical Leg: If the longest leg of the path cannot be flown with a fully loaded plane, cargo must be removed.

Quiet Hours: During restricted quiet hours, no takeoffs or landings are allowed, limiting the airfield's hours of operations.

Expected Findings

I assume a crisis causes an FOB to demand cargo that will be entirely supplied by a CONUS APOD. AMC does not have the capacity to directly deliver all cargo to the FOB, so a portion of cargo delivered in a contigency will always use the APOD and traditional airlift system. However, the only cargo that is included in the model is that required at the FOB, and which can be directly delivered to the FOB from an APOD using direct delivery aircraft.

The sample information on the following pages is theoretical output from the proposed utility model that could be used as a heuristic to establish a concept of operations for traffic flows at the start of a contingency. It is important to point at that the data used is notional, and solely intended to show how a utility model would aid decision makers in determining what type of airflow should be employed.

Table 1. Cargo Delivery (notional)

Cargo Delivery (% Daily)			Cargo Delivery (% Cumulative)		
Day	***Direct delivery***	***Traditional***	***Day***	***Direct delivery***	***Traditional***
1	1	0	***1***	1	0
2	3	0	***2***	4	0
3	5	0	***3***	9	0
4	8	1	***4***	17	1
5	10	2	***5***	27	3
6	10	4	***6***	37	7
7	10	6	***7***	47	13
8	11	7	***8***	58	20
9	11	8	***9***	69	28
10	8	9	***10***	77	37
11	7	10	***11***	84	47
12	7	11	***12***	91	58
13	4	13	***13***	95	71
14	4	15	***14***	99	86
15	1	14	***15***	100	100

The right side of Table 1, Cargo Delivery, shows the percent of cargo cumulatively delivered to the FOB within a 15 day time horizon. The 15 day period is a hypothetical time target chosen for illustration purposes; however, any timeframe could be modeled. To keep things simple, cargo requirements are listed in percent, rather than pounds or tons. The information on the left-hand side of Table 1 indicates the percent of cargo delivered each day during the crisis. For example, on day six, four percent of the total cargo required for the contingency is delivered by traditional means, and 10% by direct delivery means. After cataloging this data, utility charts could be built to show the relationship between direct delivery and traditional airlift flows versus time.

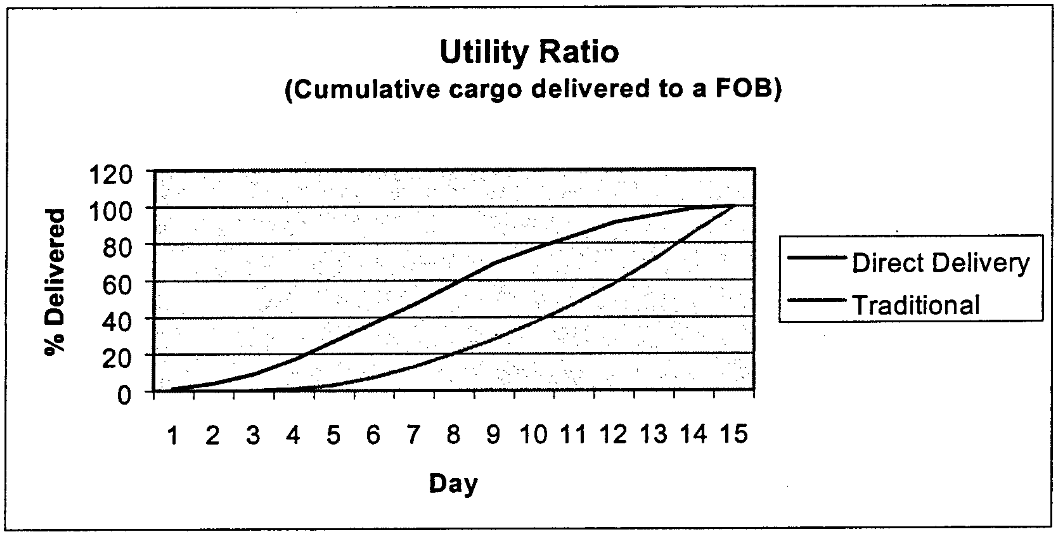

Figure 5. Utility Ratio of Cumulative Cargo Delivered (notional)

Figure 5 illustrates the differences between traditional and direct delivery airlift methods in terms of the cumulative time-phased traffic flows of cargo from an APOE to an FOB. In a traditional airlift flow, extensive enroute support and build up of material handling equipment at the APOD are required. These additional requirements are reflected in the small amount of cargo delivered to the FOB in the beginning days of the crisis. Under the traditional system, most cargo airlifted in the first few days of the crisis resupplies the APOD, or staging bases from which the operation will be run from. Bypassing the staging base, direct delivery is able to increase the amount of cargo delivered in the first days of the crisis. At the midpoint of day eight, the staging base is in full operation and capacity of the traditional airlift to the FOB begins to increase. The direct delivery flow, which required no transshipment, had already delivered over half of the required cargo by the midpoint of day eight. In this example, both methods meet the closure time of 15 days.

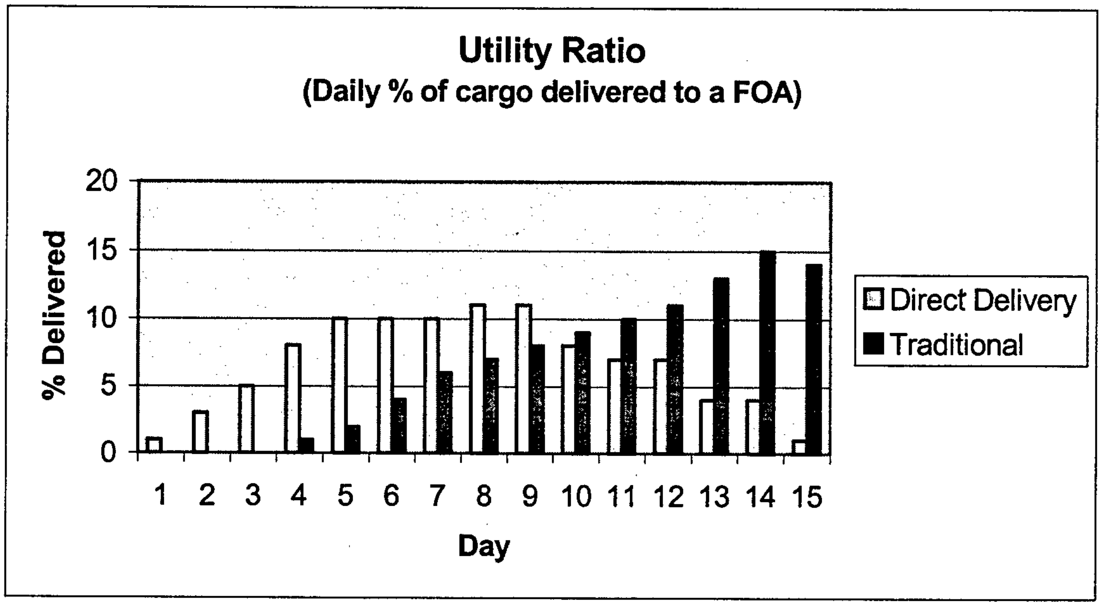

Figure 6. Utility Ratio of Percent Cargo Delivered (notional)

Figure 6 illustrates the utility ratio as a percent of cargo delivered versus time. In the traditional scenario, a large surge in traffic flows occurs during the latter portion of the operation. Direct delivery builds a sustained rate of flow earlier in the timeline, with the largest flows occurring between days five and nine. Not only is more cargo delivered earlier with the direct delivery flow, but also maximum daily traffic flows are reduced compared to traditional flows. Days 13 through 15 of the traditional flow may stress the offload capability of the FOB in order to meet the closure time. By smoothing out the peaks of the traffic flow, the direct delivery system allows for a smaller footprint of personnel and material handling equipment (MHE) at the FOB. Another important output the model must provide is a comparison of the total costs of a direct delivery operation versus those of a traditional operation.

Table 2. Total Airlift Costs (notional)

Total Airlift Costs (in %)		
Day	***Direct delivery***	***Traditional***
1	1	11.1
2	4	15.5
3	9	23.2
4	17	34.2
5	27	48.5
6	37	61.7
7	47	72.7
8	58	84.8
9	69	98
10	77	106.8
11	84	111.2
12	91	117.8
13	95	122.2
14	99	123.3
15	100	124.4

The data for Table 2 is based on the same flow shown in the previous two examples, and reflects cumulative costs in percent of total direct delivery costs. In determining the total costs for an actual model, it would be necessary to determine the traditional costs as a function of direct delivery costs. These total costs could be found by researching all expenses involved with each system. Based on a traditional two-step system requiring both strategic and tactical airlift, as well as a staging location capable of transshipment of cargo, some costs of the traditional system will be greater than those associated with a direct delivery system. In a scenario heavily contingent on aerial refueling assets, the model may show that the direct delivery scenario is more expensive. After all costs involved in each system are determined, traditional system costs could be defined as a function of direct delivery costs. For this example, I used the variable costs of the traditional system as being 10% more expensive than a direct delivery system. If the cost of delivering one pound of cargo via direct delivery is $10, then via traditional means the cost would be $11. Additionally, a 10% one-time charge is added to the fixed costs of the traditional system to account for the larger enroute structure that would be required.

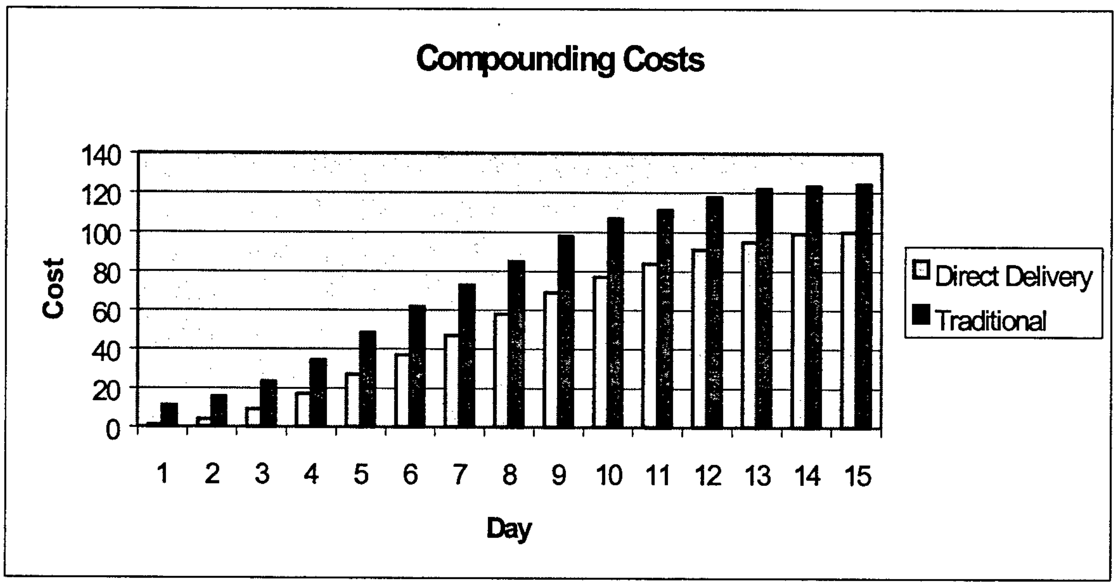

Figure 7. Compounding Costs Over Time (notional)

Figure 7 illustrates the hypothetical cumulative daily cost comparison between a traditional system versus a direct delivery system. The large cost of the traditional system on day one of the crisis is the one-time fixed charge for opening enroute-staging bases. While an enroute staging area may still be required to recover direct delivery aircraft, the support needed would be limited to fuel and maintenance for direct delivery aircraft only. In this example, the more cumbersome traditional airlift system is more expensive. From the chart, a policy maker could infer the traditional system would reach

100% of the costs incurred by the direct delivery system in day nine of the crisis. At the end of crisis, the traditional airlift structure is 24% more expensive than direct delivery to airlift the same amount of cargo. In other words, this model indicates that if the cost of this crisis were $10 million using a direct delivery structure, the cost for traditional structure would be $12.4 million.

Problems to Overcome

An airlift operation that centers on flights from the APOE non-stop to final destination will have problems that must be overcome before a direct delivery utility model can provide an accurate solution. According to Joint Publication 4-01.3, the five movement control principles are: (1) centralized control and decentralized execution; (2) fluid and flexible movements; (3) regulated movements; (4) maximized use of delivery capability; and (5) forward support. Direct delivery would initially disturb these principles, as well as upset mobility paradigms that are based on established processes (White, 1997).

Direct delivery operations improve the theater commander's flexibility for maximizing an airframe's utility, but mission support will likely become more complicated. Intelligence estimates, which aircrews use during the mission planning process, may not be sufficient or timely to ensure mission success. In a true direct delivery scenario, the crew would not be able to use traditional up-to-date mission planning information upon approach to the final destination. Direct delivery detracts from aircrew preparation for a mission by eliminating the timely face-to-face contact with mission support personnel who can best interpret recent information and provide the crew the best chances of success (White, 1997).

Direct delivery requires strict TPFDD discipline from both the user and AMC. From the perspective of the contingency planner, the FOB must be identified in the TPFDD as well as the APOD. This identification would allow the planner to sequence delivery as necessary and take full advantage of each airframe (Penny, 1996:6). The specific cargo and passengers listed under a separate Unit Line Number (ULN) for each to allow greater intransit visibility. A distinction needs to be made between cargo that may be directly delivered and cargo that must be staged. Direct delivery would be the primary option, but capacity limits will mean that the time phasing of cargo through the APOD must also be used if final delivery is accomplished by the required in-place time (White, 1997).

There are other advantages of the two-step airlift process over direct delivery. Operating out of a stage location ensures these sorties are more easily included into that day's Air Tasking Order (ATO) and have a validated slot time assignment. "Tankering" fuel, almost always a requirement of contigency operations, becomes more difficult the farther the mission originates from the final download location. Consequently, carrying excess fuel from an APOD location will significantly decrease the available cargo load (ACL) going into the FOB. The only other alternative is refueling at the FOB, an option that is not normally available (White, 1997).

The contingency cell at AMC's Tanker Airlift Control Center (TACC) is responsible for constructing the airlift flow for crisis and contingencies. The TACC must work out crew duty limitations that could cause maximum aircraft on the ground (MOG) problems at the destination or choke points elsewhere in the mission flow. It is possible, that before establishing a direct delivery operation, the TACC must first construct an air refueling bridge to accommodate the direct delivery flow. The time needed to build this air bridge would take away from the time savings direct delivery provides in the first several days of an operation.

While a model may show direct delivery as a better transportation process than the traditional "hub and spoke," it will not necessarily mean defense transportation customers will use it. The concept needs to be aggressively marketed. For instance, imagine a new policy that not only gave customers who take the time to build and use tailored, direct delivery force packages a 10% price discount on airlift, but also would guarantee delivery times that beat traditional closure estimates. Soon, airlift users would be scrambling to use the C-17 for direct delivery missions. An aggressive marketing campaign such as this would save on total transportation costs, and optimize the capabilities of the C-17.

The United States will likely always be short of strategic mobility assets. In the future, the Air Force will make a case before Congress to obtain additional strategic mobility airlift assets, possibly even requesting more C-17s. It is important today that we not forget the lessons from yesterday. Other mobility purchase options such as the Non Developmental Airlift Aircraft (NDAA), more C-5 aircraft, the Service Life Extension Program (SLEP) of the C-141 were only a few alternatives which came close to replacing the C-17. These options may work their way into the Air Force inventory in the future.

In the past, Air Force leaders have been successful in articulating the inherent value the technologically advanced C-17 added to our nation's mobility arsenal. Though the weapon system seemed expensive, mobility experts recognized that the revolutionary direct delivery capabilities made the C-17 a best value. The next time the Air Force needs to procure a next generation airlift aircraft, the track record of how the aircraft was used in past military operations will stand out. If the C-17 is not employed in its most productive capacity as a direct delivery airlifter, then the follow on strategic airlift aircraft may not provide a direct delivery capability at all.

In April 1998, Lieutenant General Sams, Vice Commander of Air Mobility Command, identified the degraded flying skills of pilots qualified to fly direct delivery sorties as a safety risk. He indicated that waiver requests had been forwarded to AMC Headquarters to accommodate for the lacking direct delivery sortie (DDS) currency requirements. Recent trend information on pilot evaluations indicated the number poor pilot proficiency ratings are increasing for small, austere airfield (SAAF) landings. The interim solution is to work with the Tanker Airlift Control Center (TACC) to increase emphasis on the direct delivery sorties and stand firm on the need for direct delivery training sorties. However, until the command embraces an operational role for direct delivery within traditional "hub and spoke" doctrine, maintaining DDS proficiency for the aircrews will be a continuing challenge (Sams, 1998).

VII. Conclusion

Direct delivery airlift may be necessary in the future to meet national policy objectives increasingly reliant on rapid force projection. Since its evolution from a vision, the global projection capability embodied in C-17 direct delivery has withstood the test of time. An appreciation of this evolutionary process will provide mobility leaders a foundation to build future policies that may someday integrate direct delivery in traditional Air Force doctrine.

A direct delivery utility model will show the value added in a direct delivery scenario versus a traditional scenario in terms of time and cost savings. Mobility leaders could use information from the model as a basis to establish operational policies at the onset of an operation to optimize the structure of the initial airlift deployment. In the past, traditional methods during large airlift operations have evolved around the build up of a large intermediary-staging base close to the AOR. However, a future operating environment governed by fewer aircraft, a smaller enroute structure, and improved intransit visibility, may make the build up of large staging bases unnecessary and inefficient in time compressed, crisis scenarios. Consequently, to more effectively employ airlift in support of tomorrow's worldwide operations, the Air Force should develop and use a policy emphasizing the direct delivery of forces.

The ability to project forward from the United States anywhere in the world is a requirement for the next century, and direct delivery can help perform that mission now. Tomorrow's deployed force will be smaller and more capable, and the mode of transportation must be more capable to provide increased flexibility. When properly employed, direct delivery will be a force multiplier. In May 1998 the Air Force Chief of

Staff, General Ryan, announced the visionary concept of a rapidly deployable Air Expeditionary Force to "project power when and where it is needed." (Ryan, 1998) A force that may finally complete the linkage between direct delivery doctrine and employment, and secure a next generation role for the C-17.

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Vita

Major Creighton W. Cook Jr. was born on 8 May 1963 in Patuxent River, Maryland. After graduation from Granada Hills High School in 1981, he entered the United States Air Force Academy in Colorado Springs, Colorado. In 1985, he graduated from USAFA with a Bachelor of Science degree in Engineering Sciences. He was awarded a Master of Arts degree in Management from Webster University in 1994.

Following his commission, Major Cook graduated Undergraduate Pilot Training at Reese AFB, Texas in August 1986. His first assignment was to Travis AFB, California piloting the C-141B Starlifter. While at Travis AFB, he commanded numerous missions in support of Operation Just Cause, Desert Shield, Desert Storm, and Restore Hope. Following this tour, Major Cook was assigned to Altus AFB as a formal school instructor and evaluator pilot in the C-141B, where he served in Standardization and Evaluation, and as Chief, C-141 Flight Operations.

In 1993, he was chosen as part of the C-17 initial cadre at Charleston AFB, South Carolina where he served as a C-17 evaluator pilot, Wing Plans Officer, and Flight Commander. While at Charleston, he commanded direct delivery missions in support of Operation Joint Endeavor and hurricane relief operations in the Eastern Caribbean. In 1996, he was chosen as the 437th Airlift Wing's Instructor Pilot of the Year. Major Cook is a senior pilot with over 4,700 flying hours. He was selected by Air Mobility Command to attend the Advanced Study of Air Mobility program in 1997. Major Cook has been assigned to United States European Command in Stuttgart, Germany.

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REPORT DOCUMENTATION PAGE	*Form Approved* *OMB No. 0704-0188*

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	June 1998	Graduate Research Paper

4. TITLE AND SUBTITLE

INTEGRATING C-17 DIRECT DELIVERY AIRLIFT
INTO TRADITIONAL AIR FORCE DOCTRINE

5. FUNDING NUMBERS

6. AUTHOR(S)

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8. PERFORMING ORGANIZATION REPORT NUMBER

AFIT/GMO/LAC/98J-3

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

AMWC/WCDA
5656 Texas Avenue
Ft Dix AIN NJ 08640

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT

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12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

Airlift is critical to a national military strategy increasingly dependent on strategic mobility to deploy U.S. and multinational forces. Airlift doctrine, the very principles that describe how this airlift should be used, has remained relatively unchanged for the past thirty years. Consequently, the traditional "hub and spoke" airlift process remains as the Air Force's fundamental airlift deployment strategy. Today, the C-17 is a next generation airlifter capable of direct delivery, but the Air Force's reluctance to integrate direct delivery within traditional airlift doctrine may be degrading the efficiency and effectiveness of our national airlift capability.

Airlift will always be a scarce resource. Airlift doctrine needs to be updated to take advantage of the rapid force projection capability direct delivery airlift can provide. This paper discusses the evolution of the C-17 direct delivery airlift capability and highlights the need to integrate this capability within current Air Force doctrine. It begins with a discussion of the original doctrine that led to a vision that our nation needed a direct delivery capability. Then follows the evolution of direct delivery from the initial concept, to aircraft development, to the operational capability that exists today with the advent of the C-17. It concludes with a proposal of a direct delivery utility model that would be beneficial in determining when to employ direct delivery in an airlift operation.

14. SUBJECT TERMS	15. NUMBER OF PAGES
Strategic Mobility, Rapid Global Mobility, C-17, Direct Delivery, Strategic Airlift, Tactical Airlift, Intertheater Airlift, Intratheater Airlift, Theater Airlift, Force Projection, Airlift Doctrine,	46
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

AFIT Control Number AFIT/GMO/LAC/98J-3

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